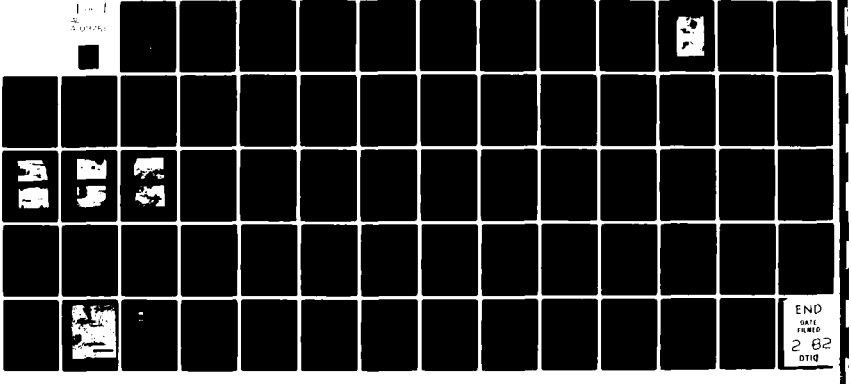
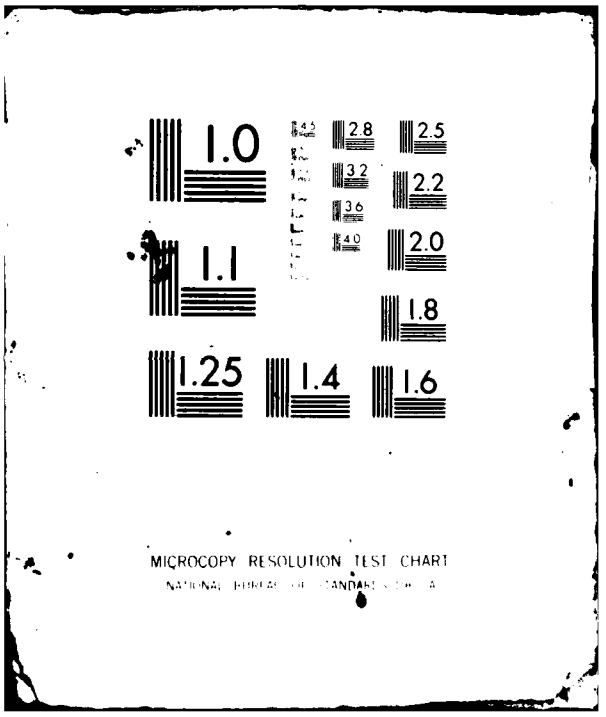
AD-A109 751 D'APPOLONIA CONSULTING ENGINEERS INC PITTSBURGH PA F/G 13/13
NATIONAL DAM SAFETY PROGRAM. TYRONE POWER COMPANY DAM (INVENTOR--ETC(U)
SEP 81 L D ANDERSEN DACW51-81-C-0011

UNCLASSIFIED NL




1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART

CHEMUNG RIVER BASIN

TYRONE POWER COMPANY DAM

SCHUYLER COUNTY, NEW YORK

INVENTORY NO. N.Y. 454

PREPARED FOR

NEW YORK DISTRICT CORPS OF ENGINEERS

AUGUST 1981

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A102 091 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase Inspection Report Tyrone Power Co. Dam Chemong River Basin, Schuyler County, NY Inventory No. 454	5. TYPE OF REPORT & PERIOD COVERED Phase I Inspection Report National Dam Safety Program 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) LAWRENCE D. ANDERSEN	8. CONTRACT OR GRANT NUMBER(s) DACW51-81-C-0011
9. PERFORMING ORGANIZATION NAME AND ADDRESS D'Appolonia Consulting Engineers, Inc. 10 Duff Road Pittsburgh, PA 15235	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Department of the Army 26 Federal Plaza New York District, CofE New York, New York 10287	12. REPORT DATE 14 September 1981 13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) Department of the Army 26 Federal Plaza New York District, CofE New York, NY 10287	15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; Distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
Dam Safety
National Dam Safety Program
Visual Inspection
Hydrology, Structural Stability
Tyrone Power Co. Dam
Chemong River Basin
Schuyler County

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report presents information and comments on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

Evaluation of the existing conditions did not reveal any conditions which constitute an immediate hazard to human life or property. However, the dam was found to have some serious deficiencies which require further evaluation and implementation of remedial measures.

DD FORM 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Using the Corps of Engineers' criteria for initial review of spillway adequacy, it was found that the nonoverflow sections of the dam would be overtopped by storms of more than fifteen percent of the Probable Maximum Flood (PMF). Because the spillway capacity is less than 50 percent of the PMF and failure of the dam would increase the hazard to downstream residents, the spillway capacity is considered to be seriously inadequate and the dam is classified as unsafe/nonemergency.

Classifying a dam as unsafe because of a seriously inadequate spillway means that if a severe storm were to occur, overtopping and failure of the dam could result, significantly increasing the loss of property downstream of the dam.

The dam consists of a concrete overflow spillway section flanked by a nonoverflow concrete wall on the right abutment and an earth embankment on the left abutment. Recently, the downstream slope of the earth embankment had been excavated to a depth of approximately 20 feet from the crest of the earth embankment section for the purpose of installing a hydroelectric generating facility. This facility is presently under construction. Constructed portions include a partially complete concrete retaining wall along the downstream face of the earth embankment and a concrete foundation for a waterwheel at the base of the retaining wall. Configuration and construction of the completed facilities are not considered to be in conformance with generally accepted engineering practice. No reference was found to indicate that any engineering analysis was conducted to size the structural components of the facility under construction. Although the completed portions do not show major signs of distress, continued stability of these facilities is considered to be questionable. Therefore, the design and construction of the existing and proposed modifications to the dam should be more completely evaluated by a professional engineer. In addition, the stability of the spillway section was found to be marginal, requiring further investigation.

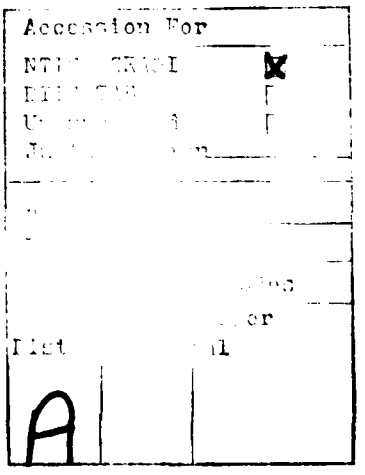
PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.



PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
TYRONE POWER COMPANY DAM
N.Y. 454
DEC I.D. NO. 54-1596
CHEMUNG RIVER BASIN
SCHUYLER COUNTY, NEW YORK

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

DAM INSPECTION REPORT

Name of Dam:	Tyrone Power Company Dam N.Y. 454
State Located:	New York
County Located:	Schuyler
Stream:	Tobehanna Creek (a tributary of Lamoka Lake)
Date of Inspection:	June 25, 1981 and July 15, 1981

ASSESSMENT

Evaluation of the existing conditions did not reveal any conditions which constitute an immediate hazard to human life or property. However, the dam was found to have some serious deficiencies which require further evaluation and implementation of remedial measures.

Using the Corps of Engineers' criteria for initial review of spillway adequacy, it was found that the nonoverflow sections of the dam would be overtopped by storms of more than fifteen percent of the Probable Maximum Flood (PMF). Because the spillway capacity is less than 50 percent of the PMF and failure of the dam would increase the hazard to downstream residents, the spillway capacity is considered to be seriously inadequate and the dam is classified as unsafe/nonemergency.

Classifying a dam as unsafe because of a seriously inadequate spillway means that if a severe storm were to occur, overtopping and failure of the dam could result, significantly increasing the loss of property downstream of the dam.

The dam consists of a concrete overflow spillway section flanked by a nonoverflow concrete wall on the right abutment and an earth embankment on the left abutment. Recently, the downstream slope of the earth embankment had been excavated to a depth of approximately 20 feet from the crest of the earth embankment section for the purpose of installing a hydroelectric generating facility. This facility is presently under construction. Constructed portions include a partially complete concrete retaining wall along the downstream face of the earth embankment and a concrete foundation for a waterwheel at the base of the retaining wall. Configuration and construction of the completed facilities are not considered to be in conformance with generally accepted engineering practice. No reference was found to indicate that any engineering analysis was conducted to size the structural components of the facility under construction. Although the completed portions do not

show major signs of distress, continued stability of these facilities is considered to be questionable. Therefore, the design and construction of the existing and proposed modifications to the dam should be more completely evaluated by a professional engineer. In addition, the stability of the spillway section was found to be marginal, requiring further investigation.

It is recommended that a further investigation should be undertaken by a professional engineer to more accurately determine the spillway capacity and the nature and extent of improvements required to provide adequate spillway capacity. It is also recommended that the structural integrity and adequacy of the facilities under construction should be evaluated by a professional engineer and necessary corrective measures undertaken. In conjunction with this work, stability of the overflow and nonoverflow sections should be investigated.

It is recommended that further investigations listed above should commence within three months of the date of notification to the owner. Measures deemed necessary as a result of these investigations should be completed within 18 months of the date of notification. Other recommendations listed below should be implemented within 12 months from issuance of this report.

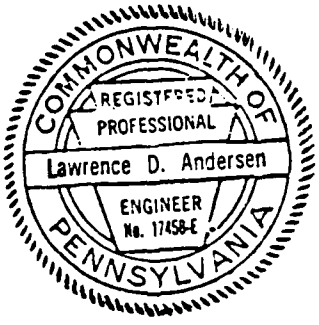
1. Low areas at the junction of the dam and right abutment should be filled.

2. Necessary steps should be taken to correct seepage through the left abutment earth embankment section and seepage under the concrete spillway sections.

3. An emergency action plan should be developed including a formal warning system to alert the downstream residents in the event of emergencies.

4. The dam and appurtenant structures should be inspected regularly and necessary maintenance should be performed.

Assessment - Tyrone Power Company Dam



Lawrence D. Andersen, P.E.
Vice President
D'Appolonia Consulting Engineers, Inc.
Pittsburgh, Pennsylvania

Approved by: _____

Col. W. M. Smith, Jr.
New York District Engineer

Date: 4 Sept 81

TYRONE POWER COMPANY DAM
N.Y. 454
DEC I.D. 54-1596
JUNE 25, 1981

OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
TYRONE POWER COMPANY DAM
N.Y. 454
DEC I.D. NO. 54-1596
CHEMUNG RIVER BASIN
SCHUYLER COUNTY, NEW YORK

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I Inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367.

b. Purpose of Inspection

The inspection was to evaluate the existing conditions of the subject dam to identify deficiencies and hazardous conditions, determine if they constitute hazards to life and property, and recommend remedial measures where necessary.

1.2 DESCRIPTION OF PROJECT

a. Dam and Appurtenances

The Tyrone Power Company Dam consists of a concrete overflow spillway section flanked by a 30-foot-long nonoverflow concrete gravity section on the right abutment (looking downstream) and a 60-foot-long earth embankment on the left abutment. The height of the dam measured from the top of the concrete nonoverflow section to the downstream stream bed is approximately 20 feet.

The main spillway section consists of a 28-foot-wide, approximately 3-foot-deep concrete overflow section which discharges onto a 9-foot-wide concrete apron, which in turn discharges into the stream bed. A 6-foot-wide, 3-foot-deep overflow section located within the 28-foot-wide overflow section is normally equipped with flashboards. The configurations of the spillway facilities are illustrated in the field sketches included in Appendix D.

The low level outlet facility for the dam consists of a 27-inch-diameter steel pipe through the right abutment structure. Flow through this pipe is apparently controlled by a sluice gate at the upstream end. The sluice gate is reported to be nonfunctional. Another outlet facility for the dam is a 20-inch-diameter steel pipe located through the earth embankment section. The pipe is intended to supply a small hydroelectric facility which is

currently under construction. For the construction of this hydroelectric facility, which includes a waterwheel and a proposed powerhouse, the downstream slope of the earth embankment section has been excavated from the downstream side of the embankment crest vertically down to the toe level of the dam. Structures under construction include a concrete retaining wall buttressed by the foundation of the waterwheel.

b. Location

The dam is located approximately 100 feet downstream from the State Route 226 bridge over Tobehanna Creek, approximately one mile upstream from the mouth of the creek at Lamoka Lake in Tyrone Township, Schuyler County, New York. Plate 1 illustrates the location of the dam.

c. Size Classification

The dam is classified as a small dam based on its 20-foot height and estimated maximum storage capacity of about 700 acre-feet.

d. Hazard Classification

The dam is classified to be in the high hazard category. A campground is located approximately one mile downstream from the dam which includes about 5 to 10 camp trailers situated adjacent to Tobehanna Creek. The floor levels of the trailers are in the range of four to six feet from the adjacent stream bed. In addition, two houses which are estimated to be within eight to ten feet in elevation from the adjacent stream bed are also considered to be within the potential floodplain of Tobehanna Creek in the event of a dam failure. Based on visual observations, it is estimated that failure of the dam would cause loss of more than a few lives and appreciable property damage in the campground area.

e. Ownership

Mr. Alfred D. Huey, R.D. 1, Box 98, Watkins Glen, New York 14891, 607-292-6608.

f. Purpose of Dam

The dam was constructed for the purpose of impounding a recreational lake.

g. Design and Construction History

The dam was designed and constructed by the owner under a State Construction Permit dated May 5, 1952. The construction of the dam was completed in about 1953.

h. Normal Operating Procedure

The reservoir is normally maintained at the crest level of the 28-foot-wide spillway. The 6-foot-wide overflow section at the base of the 28-foot-wide spillway is normally equipped with flashboards.

1.3 PERTINENT DATA

Elevations referred to in this and subsequent sections of the report were obtained from field measurements assuming the normal pool level (crest of the 28-foot-wide spillway) to be at Elevation 1185 (USGS Datum) which is interpolated from the USGS 7.5-minute Wayne quadrangle.

a. Drainage Area (sq. mi.)	11.8
b. Discharge at Dam (cfs)	
Principal spillway at top of dam[1]	430
c. Elevation (USGS Datum) (feet)	
Top of dam (right abutment nonoverflow)	1190.0
Top of dam (earth embankment)	1192.0±
Top of dam (low area on right abutment)	1188±
Auxiliary spillway crest	N/A
Principal spillway crest	1185.0
Reservoir drain, exit invert elevation	1175.0±
d. Reservoir (acres)	
Surface area at top of dam	194±
Surface area at principal spillway crest	117
e. Storage Capacity (acre-feet)	
Top of dam	700
Principal spillway crest	340
f. Dam	
Type	Concrete gravity/ earth embankment
Length	100± feet
Height	20 feet
Top width	15 feet
Side slopes	Downstream: Vertical Upstream: Vertical
Zoning	Unknown
Impervious core	Unknown
Cutoff	Unknown
Grout curtain	Unknown
g. Primary Spillway	
Type	Concrete overflow
Length	28 feet (weir length)
Crest elevation	1185.0

[1] Capacity based on the head available relative to top of ground (low area) at the right abutment junction.

h. Regulating Outlet (right abutment)	
Type	27-inch steel pipe
Length	20± feet
Access	Downstream end
Regulating facilities	Apparently a sluice gate (reported nonfunctional)
i. Regulating Outlet (left abutment)	
Type	20-inch steel pipe
Length	20± feet
Access	Downstream end
Regulating Facility	Upstream sluice gate

SECTION 2: ENGINEERING DATA

2.1 DATA AVAILABLE

Available information was obtained from New York State Department of Environmental Conservation, Dam Safety Division files. The available information includes the original State Construction Permit, a State Construction Permit dated September 8, 1980 for the current modifications of the dam, limited design calculations associated with the original design, and a design sketch showing plans for the current modifications.

2.2 GEOLOGY

The Tyrone Power Company Dam is located in the glaciated Allegheny Plateau section of the Appalachian Plateau Province. This region is characterized as a maturely dissected plateau with the topographic features modified by continental glaciation. The modification consists of rounding off of the high areas and deposition of glacial till in the valleys.

The dam site is located south of the axis of a northeast trending anticline (trending approximately north 70 degrees east). The folding is gentle with a maximum dip of the limbs of one to two degrees. The dip of the strata is affected locally by the folding; however, regionally, the rock strata dip south to southwest at approximately 100 to 150 feet per mile. The most prominent fracture orientations in the region have a strike of north 10 degrees west to 10 degrees east with a vertical dip. A secondary fracture trace strike north 70 degrees west to east-west and is vertical, while a less prominent fracture strikes north 60 degrees east.

The rock strata in the area consist of unconsolidated Pleistocene glacial till (Wisconsin Drift) underlain by strata of the Sonyea Group (Upper Devonian Age). The glacial till consists of a mixture of clay and silt with varying quantities of gravel. The glacial till is relatively thin on hilltops and slopes and thicker in the valleys. The bedrock consists of a thick sequence of interbedded gray calcareous shale, gray and greenish-gray siltstone and silty shale, brown, gray, and dark gray shale, and black fissile shale. The tops of the surrounding hills consist of dark gray to black shale and siltstone.

The abutment slopes are relatively gentle and not susceptible to landslide slope movement.

2.3 SUBSURFACE INVESTIGATION

No reference was found to indicate that a subsurface investigation was conducted prior to construction.

2.4 EMBANKMENT AND APPURTENANT STRUCTURES

As noted before, no design and construction drawings are available for the dam. Sketches in Plate 3 illustrate the plan view, elevation, and typical cross section of the spillway based on approximate field measurements. The dam consists of a central gravity spillway section flanked by a gravity section on the right and an earth embankment on the left. Field observations along the downstream base of the gravity sections suggest that the gravity sections were not keyed into the foundation rock.

2.5 CONSTRUCTION RECORDS

No construction records are available. No reference was found to indicate the manner in which the dam was constructed. Because no design information is available, it could not be determined whether or not the existing structure is in conformance with original design.

2.6 OPERATING RECORDS

No operating records are maintained.

2.7 EVALUATION OF DATA

The available design and construction information is very limited and is not considered to be adequate to assess the adequacy of the design of the dam.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General

Visual inspections of the dam were conducted on June 25 and July 15, 1981. On both dates, the pool level was approximately at the crest level of the 28-foot-wide spillway section.

b. Dam

Plate 3 illustrates the field observations. As previously noted, the dam consists of a concrete overflow section flanked by a non-overflow concrete wall on the right abutment and an earth embankment on the left abutment. Recently, the downstream slope of the earth embankment has been excavated to a depth of approximately 20 feet from the crest of the earth embankment section. A concrete retaining wall has been constructed across a portion of the excavated face to retain the earth embankment.

The most significant condition noted was the apparent structural inadequacy of the new retaining wall on the downstream side of the earth embankment. A large structural crack was observed at the top of the new retaining wall. Because the downstream face of the wall has recently been plastered, the vertical extent of this crack could not be determined. Scrap metal pieces were found to be protruding from the concrete wall sections, raising concern as to whether such material has been used as reinforcement for the concrete. In general, the new construction is not considered to be in conformance with generally accepted civil engineering practice. Some structural cracking was observed in the old concrete section, raising concern that the current construction is distressing the old concrete sections.

Other observations include numerous seepages through the spillway and earth embankment sections and structural cracking in the old and new concrete sections. Discharge from the seepages was estimated to be in the range of 10 to 20 gallons per minute. As shown on Plate 3, a low area exists at the junction of the dam and the right abutment. The top of ground in this low area is estimated to be about 3 feet above the crest of the 28-foot-wide spillway.

c. Spillway

The spillway is a concrete gravity section and, in general, was found to be in satisfactory condition. Based on visual observations, it appears that the concrete was not keyed into the foundation rock along the downstream toe of the spillway section. A 6-foot-wide, 3-foot-deep overflow section located along the bank of the 28-foot-wide overflow section is normally equipped with flashboards. This section would function as a primary spillway if flashboards were to be removed.

d. Reservoir Drain

This 6-foot-wide, 3-foot-deep section within the 28-foot-wide spillway is normally equipped with flashboards. Therefore, the lake can be lowered by three feet by removing the flashboards. Other drain facilities include a 27-inch steel pipe located through the right abument and a 20-inch steel pipe through the earth embankment section. Flow through these pipes is controlled by sluice gates located at the upstream face. It is reported that while the sluice gate of the 27-inch pipe is nonfunctional, the sluice gate of the 20-inch pipe is functional. However, operation was not observed.

e. Downstream Channel

The stream immediately below the dam is littered with construction debris. However, it is not considered to significantly reduce the discharge capacity of the channel. Further description of the downstream conditions is included in Section 1.2 d.

f. Reservoir

There are no visible signs of instability or sedimentation at the immediate vicinity of the dam within the reservoir.

3.2 EVALUATION

The structure of the dam was found to be in poor condition. Concerns exist as to the structural adequacy of the retaining wall and other facilities under construction.

The following conditions were observed:

1. The vertical cut into the left abutment for the powerhouse construction is unprotected. The cut should be shored to prevent a sliding failure which could threaten the overall stability of the earth section of the dam.

2. The design and construction of the retaining wall currently under construction is not considered to be in conformance with generally accepted civil engineering practice. This structure should be reevaluated by a professional engineer and necessary modifications should be performed.

3. Structural cracking was observed in the old concrete sections. The need for remedial work should be investigated in conjunction with reevaluation of the dam.

4. Seepage conditions exist at numerous locations in the dam. The need for implementing measures to control seepage should be evaluated.

5. The low area at the right abutment embankment junction should be filled.

6. The reservoir drain facilities should be restored to provide adequate operation.

SECTION 4: OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

The reservoir is normally maintained at the crest level of the 28-foot-wide spillway with excess inflow discharging over the spillway. The dam has no formal operating procedure.

4.2 MAINTENANCE OF THE DAM

The dam is maintained by the owner. Portions of the dam are under construction. The low level outlet facility, located on the right side of the spillway, is reported to be nonfunctional.

4.3 WARNING SYSTEM IN EFFECT

There is no formal warning system in effect. The owner's residence is located in the immediate vicinity of the dam.

4.4 EVALUATION

The dam and appurtenant structures have not been adequately maintained. The main low level outlet facility for the dam should be repaired to permit drawdown of the lake in the event of an emergency. Also, a formal warning plan should be developed to alert the downstream residents in the event of an emergency.

SECTION 5: HYDRAULIC/HYDROLOGY

5.1 DRAINAGE AREA CHARACTERISTICS

The Tyrone Power Company Dam has a drainage area of 11.8 square miles. The drainage area is comprised of woodlands and pasturelands with gentle to moderate relief.

5.2 ANALYSIS CRITERIA

As previously stated, the Tyrone Power Company Dam is classified as a small dam in the high hazard category. Under the recommended criteria for evaluating emergency spillway discharge capacities, such impoundments are required to pass one-half to full PMF.

The PMF inflow hydrograph for the reservoir was determined using the Dam Safety Version of the HEC-1 computer program developed by the Hydrologic Engineering Center of the U.S. Army Corps of Engineers. The data used for the computer input are presented in Appendix D.

5.3 SPILLWAY CAPACITY

The elevation of the spillway section of the dam is illustrated in Plate 3. The three-foot-deep, six-foot-wide overflow section at the base of the 28-foot-wide spillway is normally equipped with flashboards. The discharge capacity of the 28-foot overflow section, based on the head available relative to the top of ground at the right abutment dam junction (lowest elevation along dam crest El. 1188±), is estimated to be 430 cfs.

5.4 RESERVOIR CAPACITY

The storage capacity is estimated to be 340 acre-feet at normal pool level and approximately 700 acre-feet at the top of the dam.

5.5 FLOODS OF RECORD

No records are available.

5.6 OVERTOPPING POTENTIAL

The PMF inflow hydrograph was determined according to the recommended procedure and was found to have a peak flow of about 16,805 cfs. The peak flow for 50 percent of the PMF was found to be 8402 cfs. Various percentages of the PMF inflow hydrograph were routed through the reservoir and it was found that the dam can pass approximately five percent of the PMF without overtopping the low area on the right abutment. The dam would pass approximately 15 percent of the PMF without overtopping the nonoverflow sections. For 50 percent of the PMF, the earth embankment section would be overtopped for approximately

30 hours, with a maximum depth of about 3 feet. For full PMF, the overtopping duration and depth would be 40 hours and 6.5 feet.

5.7 EVALUATION

The spillway was found to pass approximately 15 percent of the PMF without overtopping the crest of the earth embankment, and 5 percent of the PMF without overtopping the low area at the right abutment embankment junction. Because the spillway capacity is less than 50 percent of the PMF and it is estimated that failure of the dam due to overtopping would significantly increase the hazard to downstream residents, the spillway is considered to be seriously inadequate.

SECTION 6: STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

As discussed in Section 3, concerns exist as to the structural adequacy of the retaining wall supporting the downstream face of the earth embankment in providing continued support for the earth embankment. No reference was found regarding any design calculations that would indicate the retaining wall under construction was designed to resist the earth pressure that will be imposed by the embankment. In general, the configuration and construction of the retaining wall and associated structures are not considered to be in conformance with generally accepted engineering practice. A detailed reevaluation of the structural adequacy of the work under construction by a professional engineer is recommended.

b. Design and Construction Data

No design drawings are available for the dam. Stability analysis included in the available information was reviewed. However, the cross section which was analyzed was not in conformance with the as-built configuration of the dam, and the stability analysis is not considered to be valid for the existing structure.

c. Stability Analysis

A preliminary stability analysis of the gravity spillway section was conducted under normal pool and 50 percent of the PMF and is included in Appendix G. The results indicate that the section has adequate factors of safety against overturning and sliding for normal pool loading conditions with full uplift and no tailwater. However, for normal pool and ice loading conditions and under 50 percent PMF loading conditions, the resultant of the forces is outside the middle one-third of the base of the section, indicating inadequate resistance to overturning under these conditions. The following table summarizes the results of the preliminary stability analysis.

Loading Condition	Location of Resultant from Toe	Sliding Factor of Safety
Normal Pool	4.7 feet	2.9
Normal Pool + Ice Load	1.1 feet	Less than 1
50 percent PMF	Outside of base	Less than 1

Location of the middle one-third of the base is 4.2 to 8.3 feet from the downstream toe.

The above preliminary analysis indicates that the overflow section of the dam does not have an adequate factor of safety against

overturning and sliding other than normal pool loading conditions. Therefore, a detailed analysis should be conducted to determine the nature and extent of measures required to provide an adequately stable structure. In conjunction with this analysis, stability of the nonoverflow sections (right abutment) should also be investigated.

d. Postconstruction Changes

As previously noted, the dam is being modified to install a small hydroelectric generating facility.

e. Seismic Stability

The dam is located at the border of Seismic Zones 1 and 2. Because the static stability of the dam is questionable, the seismic stability is also considered to be questionable. Seismic stability of the structure should be evaluated in conjunction with a detailed evaluation of the dam.

SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety

In view of the seriously inadequate spillway capacity, the condition of the Tyrone Power Company Dam is considered to be unsafe/nonemergency.

The spillway capacity was evaluated according to the recommended procedure and was found to pass approximately 15 percent of the PMF without overtopping the dam, and 5 percent of the PMF without overtopping the low area on the right abutment embankment junction. Because the dam cannot pass one-half of the PMF without overtopping and it is estimated that a dam failure would significantly increase the loss of life and damage potential downstream from the dam, the spillway is classified to be seriously inadequate.

The ongoing construction was not found to be in conformance with generally accepted civil engineering practice. Concerns exist as to the continued stability of the retaining wall and other construction along the downstream side of the earth embankment. Evaluation of the structural adequacy of the current modifications of the dam by a professional engineer is recommended. The stability of the spillway section was found to be marginal, requiring further investigation.

Several seepage points were observed throughout the embankment and below the spillway structures. The need for implementing measures to control the seepage should be evaluated.

b. Adequacy of Information

Available information, in conjunction with visual observations, is considered to be sufficient to make a Phase I evaluation.

c. Need for Additional Investigations

Since the spillway is assessed to be seriously inadequate, additional hydrologic/hydraulic investigations are required to more accurately determine the characteristics of the watershed and the nature and extent of improvements required to provide adequate spillway capacity.

Investigation of the structural adequacy of the ongoing modifications and the seepage conditions is also required.

d. Urgency

The additional hydrologic and hydraulic investigations and evaluation of the structural adequacy of the recent modification to the dam should commence within three months of the date of notification to the owner.

Measures deemed necessary as a result of these investigations should be completed within 18 months of the date of notification. Other recommendations should be implemented within 12 months of the date of notification.

7.2 RECOMMENDATIONS

1. A further investigation should be undertaken by a professional engineer to more accurately determine the spillway capacity and the nature and extent of improvements required to provide adequate spillway capacity.

2. The structural integrity and adequacy of the facilities under construction should be evaluated by a professional engineer and necessary corrective measures undertaken. In conjunction with this work, stability of the overflow and nonoverflow sections should be investigated.

3. Low areas at the junction of the dam and right abutment should be filled.

4. Necessary steps should be taken to correct seepage through the left abutment earth embankment section and seepage under the concrete spillway sections.

5. An emergency action plan should be developed including a formal warning system to alert the downstream residents in the event of emergencies.

6. The dam and appurtenant structures should be inspected regularly and necessary maintenance should be performed.

APPENDIX A

PHOTOGRAPHS

PHOTOGRAPH NO. 1
Spillway

PHOTOGRAPH NO. 2
Spillway (looking downstream)

PHOTOGRAPH NO. 3
Waterwheel Under Construction

PHOTOGRAPH NO. 4
Seepage Through Base of Waterwheel
(note lack of foundation)

PHOTOGRAPH NO. 5
Voids Under Gravity Spillway Section

PHOTOGRAPH NO. 6
Campgrounds (approximately 0.5 mile downstream)

APPENDIX B

VISUAL INSPECTION CHECKLIST

APPENDIX B
VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam Tyrone Power Company Dam

Fed. I.D. # N.Y. 454 DEC Dam No. 54-1596

River Basin Chemung River Basin

Location: Town Tyrone County Schuyler

Stream Name Tobehanna Creek

Tributary of Lamoka Lake

Latitude (N) 42° 24.7' Longitude (W) 77° 03.2'

Type of Dam Concrete gravity

Hazard Category High hazard

Date(s) of Inspection June 25, 1981 and July 15, 1981

Weather Conditions Sunny, Temp. 60 degrees

Reservoir Level at Time of Inspection El. 1278.0

b. Inspection Personnel Lawrence Andersen, P.E.; James Poellot, P.E.; Bilgin Erel, P.E.; and Michael Bort

c. Persons Contacted (Including Address & Phone No.)

Mr. Alfred D. Huey, R.D. #1, Box 98, Watkins Glen, New York 14891, (607) 292-6608

d. History:

Date Constructed 1953 Date(s) Reconstructed 1981

Designer Mr. Alfred Huey

Constructed by Mr. Alfred Huey

Owner Mr. Alfred Huey

2) Embankment

a. Characteristics

(1) Embankment Material Concrete/earth

(2) Cutoff Type Unknown

(3) Impervious Core Unknown

(4) Internal Drainage System Unknown

(5) Miscellaneous --

b. Crest

(1) Vertical Alignment Good

(2) Horizontal Alignment Good

(3) Surface Cracks N/A

(4) Miscellaneous --

c. Upstream Slope

(1) Slope (Estimate) Vertical (concrete and masonry block wall).

(2) Undesirable Growth or Debris, Animal Burrows N/A

(3) Sloughing, Subsidence or Depressions N/A

(4) Slope Protection N/A

(5) Surface Cracks or Movement at Toe Not visible.

d. Downstream Slope

(1) Slope (Estimate) Vertical (concrete wall and vertical cut).

(2) Undesirable Growth or Debris, Animal Burrows N/A

(3) Sloughing, Subsidence or Depressions The downstream slope has been excavated. A partial concrete retaining wall is supporting the earth embankment.

(4) Surface Cracks or Movement at Toe None visible.

(5) Seepage A 5 to 10 gallon per minute seepage at the right spillway apron toe (see Plate 3 for location).

(6) External Drainage System (Ditches, Trenches, Blanket)

None

(7) Condition Around Outlet Structure Good

(8) Seepage Beyond Toe A 10 to 20 gallon per minute seepage in the area of the waterwheel foundation (see Plate 3).

e. Abutments - Embankment Contact

A vertical cut exists on the downstream side of the dam near the left abutment.

(1) Erosion at Contact Vertical cut is susceptible to rapid erosion.

(2) Seepage Along Contact Wet, no measurable seepage.

3) Drainage System

a. Description of System None

b. Condition of System

c. Discharge from Drainage System

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, etc.)

None

5) Reservoir

a. Slopes Gentle slopes, no problems observed.

b. Sedimentation None observed.

c. Unusual Conditions Which Affect Dam None

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.) Two houses and a campground, including 5 to 10 trailers located approximately one mile downstream, are considered to be within the potential floodplain of Tobehanna Creek.

b. Seepage, Unusual Growth None

c. Evidence of Movement Beyond Toe of Dam None

d. Condition of Downstream Channel No problem in the vicinity of the dam.

7) Spillway(s) (Including Discharge Conveyance Channel)

a. General Service Spillway: Concrete overflow section. Auxiliary Spillway: There is no formal emergency spillway.

b. Condition of Service Spillway Generally satisfactory. Some concrete deterioration.

c. Condition of Auxiliary Spillway N/A

d. Condition of Discharge Conveyance Channel Spillway channel littered with construction debris. However, not to an extent to restrict flow.

8) Reservoir Drain/Outlet

Type: Pipe X Conduit _____ Other _____

Material: Concrete _____ Metal X Other _____

Size: 20-inch-diameter and 27-inch-diameter Length Unknown

Invert Elevations: Entrance Unknown Exit Unknown

Physical Condition (Describe): Only the downstream end of the pipes are visible.

Material: Steel

Joints: -- Alignment --

Structural Integrity: Unknown

Hydraulic Capability: Unknown

Means of Control: Gate X Valve _____ Uncontrolled _____

Operation: Operable X Inoperable X Other _____

Present Condition (Describe): The sluice gate for the 27-inch-diameter pipe is reported inoperable; the 20-inch-diameter pipe is reported operable (operation not observed).

9) Structural

a. Concrete Surfaces Generally in good condition.

b. Structural Cracking Cracks in concrete walls ranging in size from one-eighth to one inch (see Plate 3).

c. Movement - Horizontal & Vertical Alignment (Settlement)

None visible.

d. Junctions with Abutments or Embankments The downstream slope of the left earth embankment has been excavated to a depth of 20 feet to install a hydroelectric generating facility.

e. Drains - Foundation, Joint, Face Unobservable

f. Water Passages, Conduits, Sluices None

g. Seepage or Leakage Seepage under the dam at several locations (see Plate 3).

h. Joints - Construction, etc. None

i. Foundation Unobservable

j. Abutments The left abutment has a partially complete concrete retaining wall which is not considered to be in conformance with generally accepted civil engineering practices.

k. Control Gates None

l. Approach & Outlet Channels Good

m. Energy Dissipators (Plunge Pool, etc.) N/A

n. Intake Structures N/A

o. Stability Unknown

p. Miscellaneous ---

10) Appurtenant Structures (Power House, Lock, Gatehouse, Other)

a. Description and Condition Waterwheel for a small hydroelectric generating facility is under construction.

APPENDIX C

ENGINEERING DATA CHECKLIST

APPENDIX C
ENGINEERING DATA CHECKLIST
NAME OF DAM: TYRONE POWER COMPANY DAM

AREA-CAPACITY DATA:

	Elevation (feet)	Surface Area (acres)	Storage Capacity (acre-feet)
1) Top of Dam	1187.8	194.0±	700.0±
2) Design High Water (Max. Design Pool)	N/A	N/A	N/A
3) Pool Level with Flashboards	1185.0	117.0	340.0
4) Service Spillway Crest	1185.0	117.0	340.0
5) Crest of Orifice (Normal Pool)	N/A	N/A	N/A

DISCHARGES

	Discharge (cfs)
1) Average Daily	25 ±
2) Principal Spillway with Flashboards (Top of Dam)	430
3) Auxiliary Spillway	N/A
4) Total of All Facilities at Maximum High Water	430
5) Maximum Known Flood	Unknown
6) At Time of Inspection	2 ±

Hydrometerological Gages:

Type: None

Location: N/A

Records:

Date - N/A

Max. Reading - N/A

FLOODWATER CONTROL SYSTEM:

Warning System: None

Method of Controlled Releases (Mechanisms):

None

DRAINAGE AREA: 11.8 square miles (planimetered from USGS topographic map).

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: Wood, farm and marshlands.

Terrain - Relief: Moderate slope.

Surface - Soil: Glacial till (low permeability).

Runoff Potential (existing or planned extensive alterations to existing surface or subsurface conditions)

High runoff potential due to moderate slope and low infiltration rate.

Potential Sedimentation Problem Areas (natural or man-made; present or future)

None observed.

Potential Backwater Problem Areas for Levels at Maximum Storage Capacity Including Surcharge Storage:

None observed.

Dikes - Floodwalls (overflow and nonoverflow) - Low Reaches Along the Reservoir Perimeter:

Location: None

Elevation:

Reservoir:

Length at Maximum Pool: 13,200 feet

Length of Shoreline at Spillway Crest: 17,000±

APPENDIX D

HYDROLOGY AND HYDRAULIC ANALYSES

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: Tyrone Power Company Dam (NY DEC 54-1596)

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.0 INCHES/24 HOURS(1)

STATION	1	2	3	4	5
Station Description	Tyrone Power Company Dam Reservoir	Tyrone Power Company Dam			
Drainage Area (square miles)	11.8	--			
Cumulative Drainage Area (square miles)	11.8	11.8			
Adjustment of PMF for Drainage Area (%)					
6 Hours	116	--			
12 Hours	126	--			
24 Hours	141	--			
48 Hours	151	--			
72 Hours	--	--			
Snyder Hydrograph Parameters					
C_p/C_t(2)	0.60/2.18	--			
L (miles)(3)	6.31	--			
L_{ca} (miles)(3)	2.8	--			
$t_p = C_t(L \cdot L_{ca})^{0.3}$ (hours)	5.16	--			
Spillway Data					
Crest Length (ft)	--	28.0			
Freeboard (ft)	--	2.8			
Discharge Coefficient	--	3.2			
Exponent	--	1.5			

(1) Hydrometeorological Report 33 (Figure 1), U.S. Army, Corps of Engineers, 1956.
(2) Snyder's Coefficients.
(3) L = Length of longest water course from outlet to basin divide.
L_{ca} = Length of water course from outlet to point opposite the centroid of drainage area.

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  01 APR 80
**********
    1                A1       SNYDER UNIT HYDROGRAPH, SPILLWAY AND DAM OVERTOPPING ANALYSES
    2                A2       TYRONE POWER DAM,(NY 54-1596),SCHUYLER COUNTY,N.Y. PROJ. NO. 80-778-19
    3                A3       FOR 5%,10%,15%,50%,60%,70%,80%,90%,AND 100% PROBABLE MAXIMUM FLOOD(PMF)
    4                B     300        0       30        0        0        0        0        0       -4        0
    5                B1      5
    6                J       1        9        1
    7                J1  0.05     0.10     0.15     0.50     0.60     0.70     0.80     0.90     1.00
    8                K       0        1                                           1
    9                K1       CALC. OF SNYDER INFLOW HYDROGRAPH TO TYRONE POWER DAM, (N.Y. 54-1596)
   10                N       1        1    11.8             11.8                                    1
   11                P                22.0      116      126      141      151
   12                T                                                          1.0     0.05            0.0154
   13                W    5.16     0.60
   14                X    -1.5    -0.05      2.0                 -
   15                K       1        2                                           1
   16                K1       ROUTING FLOW THROUGH TYRONE POWER DAM, (N.Y. 54-1596)
   17                Y                                         1        1
   18                Y1      1                                                -1185.0
   19                SA   39.5    193.6    349.9
   20                SE1180.0  1190.0  1200.0
   21                SS1185.0     28.5     3.22      1.5
   22                SD1187.8     2.80      1.5    190.0
   23                SL    8.0     22.5     37.5     55.0     85.0    115.0    160.0    194.0
   24                SV1187.8  1187.9  1188.9  1190.1  1192.1  1193.0  1193.9  1195.5
   25                K      99
```

COMPUTER INPUT OVERTOPPING ANALYSIS
PAGE D2 OF 4

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1 .05	RATIO 2 .10	RATIO 3 .15	RATIO 4 .50	RATIO 5 .60	RATIO 6 .70	RATIO 7 .80	RATIO 8 .90	RATIO 9 1.00
HYDROGRAPH AT	1	11.80	1	840.	1680.	2521.	8402.	10083.	11763.	13444.	15124.	16805.
		(30.56)		(23.79)(	47.59)(	71.38)(	237.93)(	285.52)(	333.10)(	380.69)(	428.28)(	475.86)
ROUTED TO	2	11.80	1	433.	1038.	1713.	7193.	8822.	10469.	12096.	13765.	15383.
		(30.56)		(12.27)(	29.38)(	48.50)(	203.68)(	249.80)(	296.44)(	342.51)(	388.99)(	435.54)

SUMMARY OF DAM SAFETY ANALYSIS

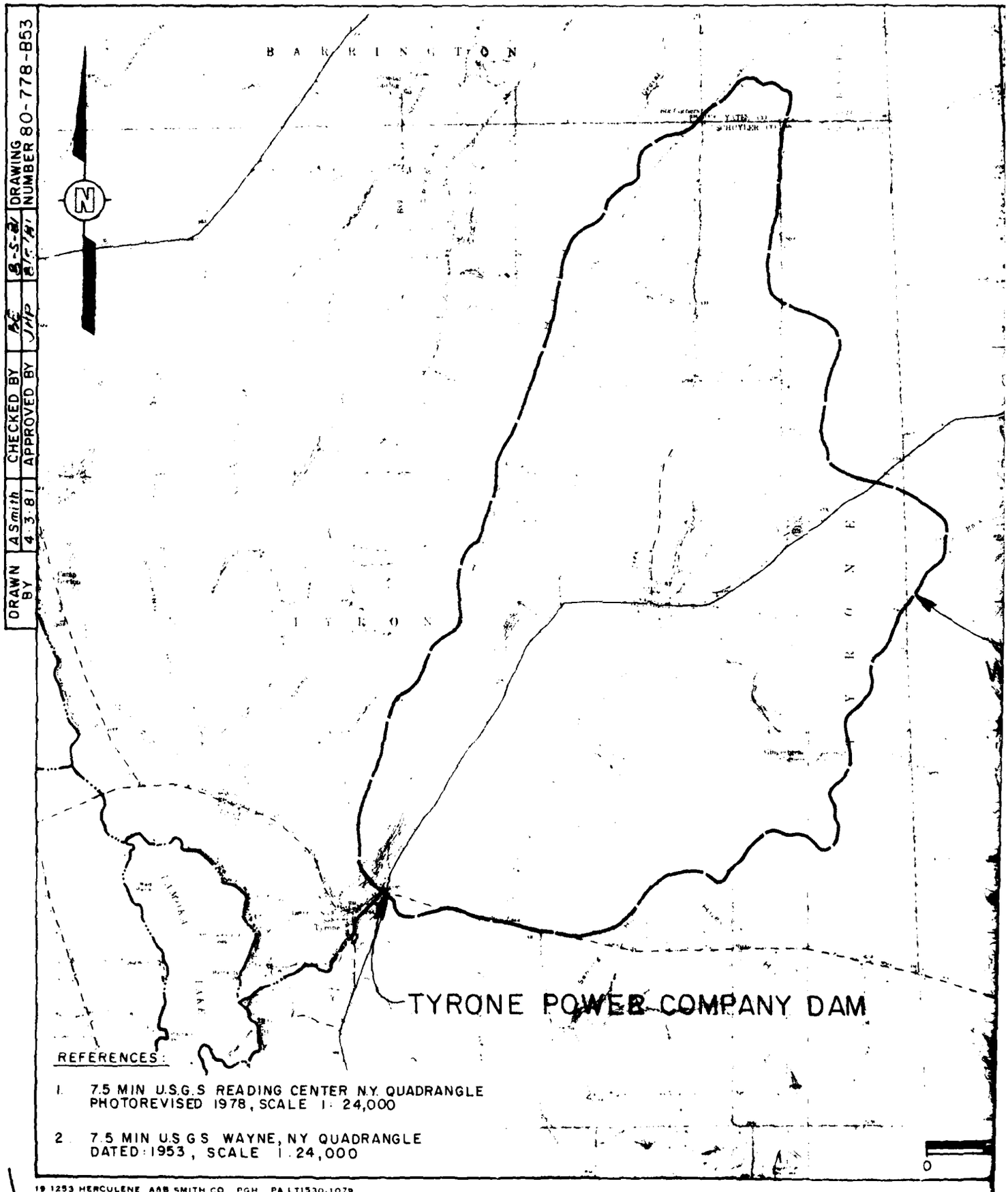
PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1185.00	1185.00	1187.80
STORAGE	342.	342.	697.
OUTFLOW	0.	0.	450.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.05	1187.81	.01	694.	433.	1.50	45.50	[illegible]
.10	1189.41	1.61	959.	1038.	16.00	48.50	[illegible]
.15	1190.54	2.74	1176.	1713.	20.00	48.00	[illegible]
.50	1195.06	7.26	2230.	7193.	31.50	46.50	[illegible]
.60	1195.86	8.06	2448.	8822.	33.50	45.50	[illegible]
.70	1196.58	8.78	2655.	10469.	35.50	45.00	[illegible]
.80	1197.25	9.45	2854.	12096.	37.50	47.00	[illegible]
.90	1197.88	10.08	3046.	13705.	39.00	46.00	[illegible]
1.00	1198.47	10.67	3234.	15305.	40.00	47.00	[illegible]

APPENDIX E

PLATES



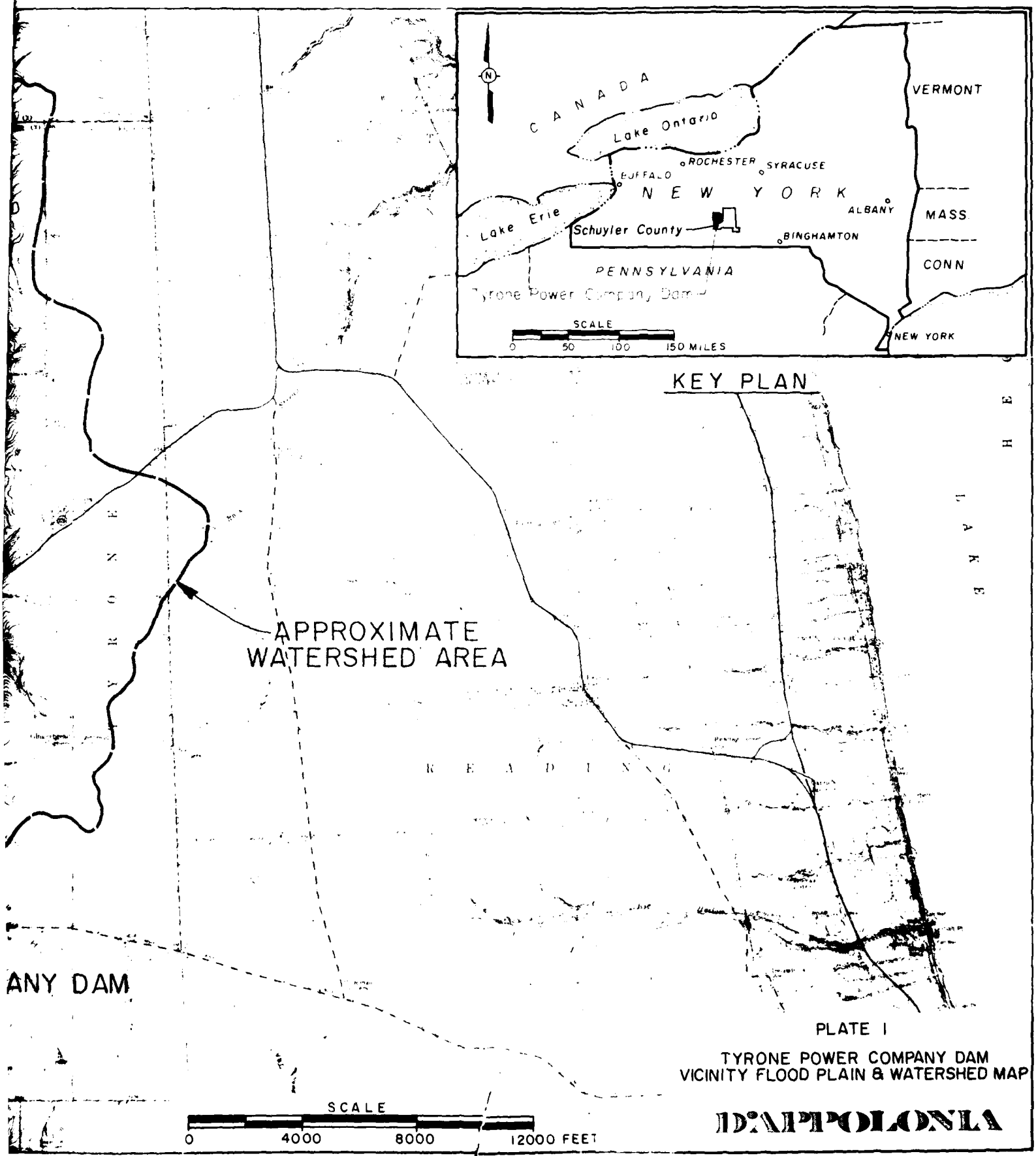
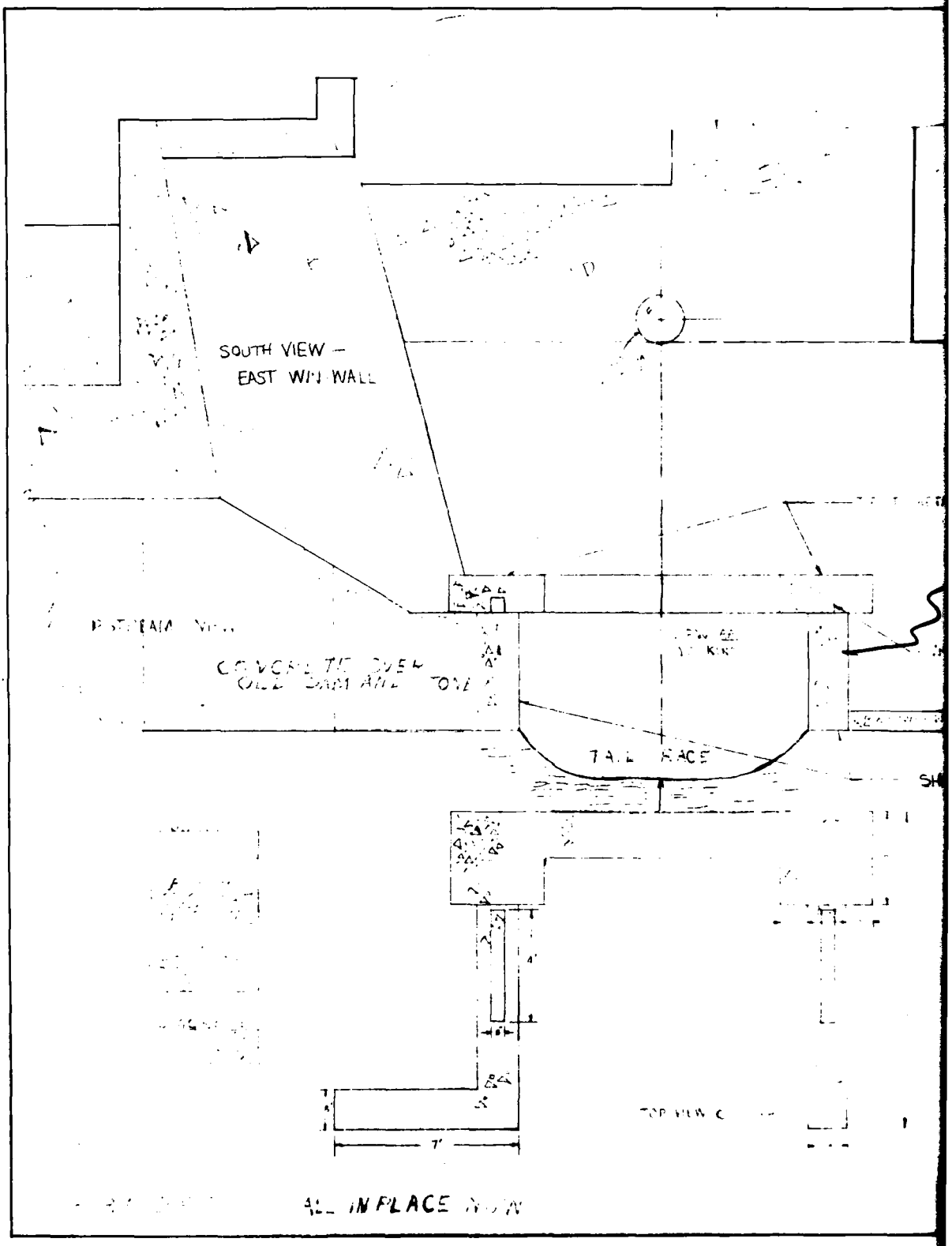


PLATE I

TYRONE POWER COMPANY DAM
VICINITY FLOOD PLAIN & WATERSHED MAP

DAPPOLONIA

DRAWN BY	ASmith	CHECKED BY	RE	8-5-81	DRAWING NUMBER 80-778-B54
	8-2-81	APPROVED BY	JMP	8/5/81	



ALL IN PLACE

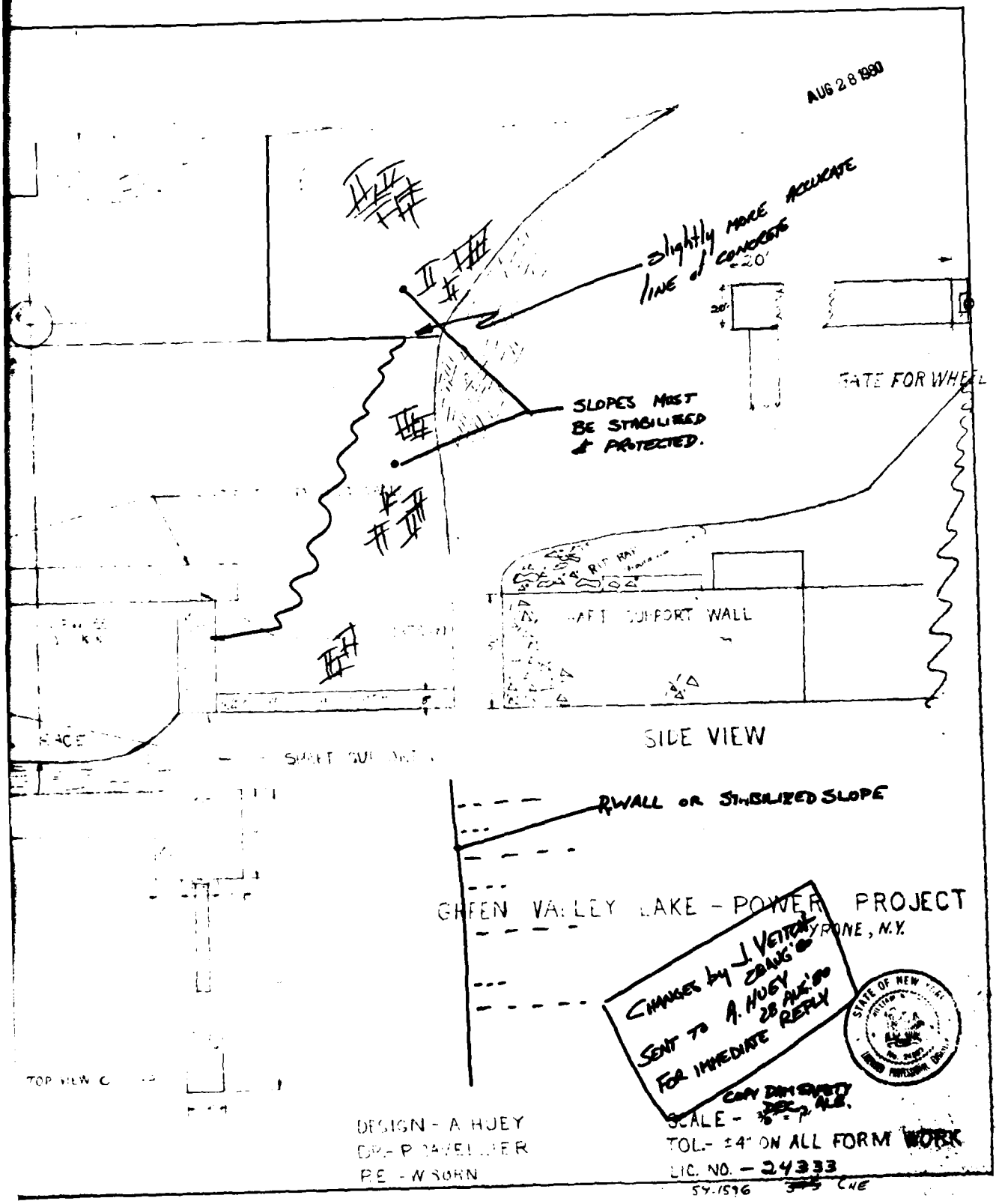


PLATE 2

DAPPOLONIA

DRAWN BY	CHECKED BY		DRAWING NUMBER
A Smith 8-4-81	APPROVED BY		80-778-A11
	JJP	8-5-81	

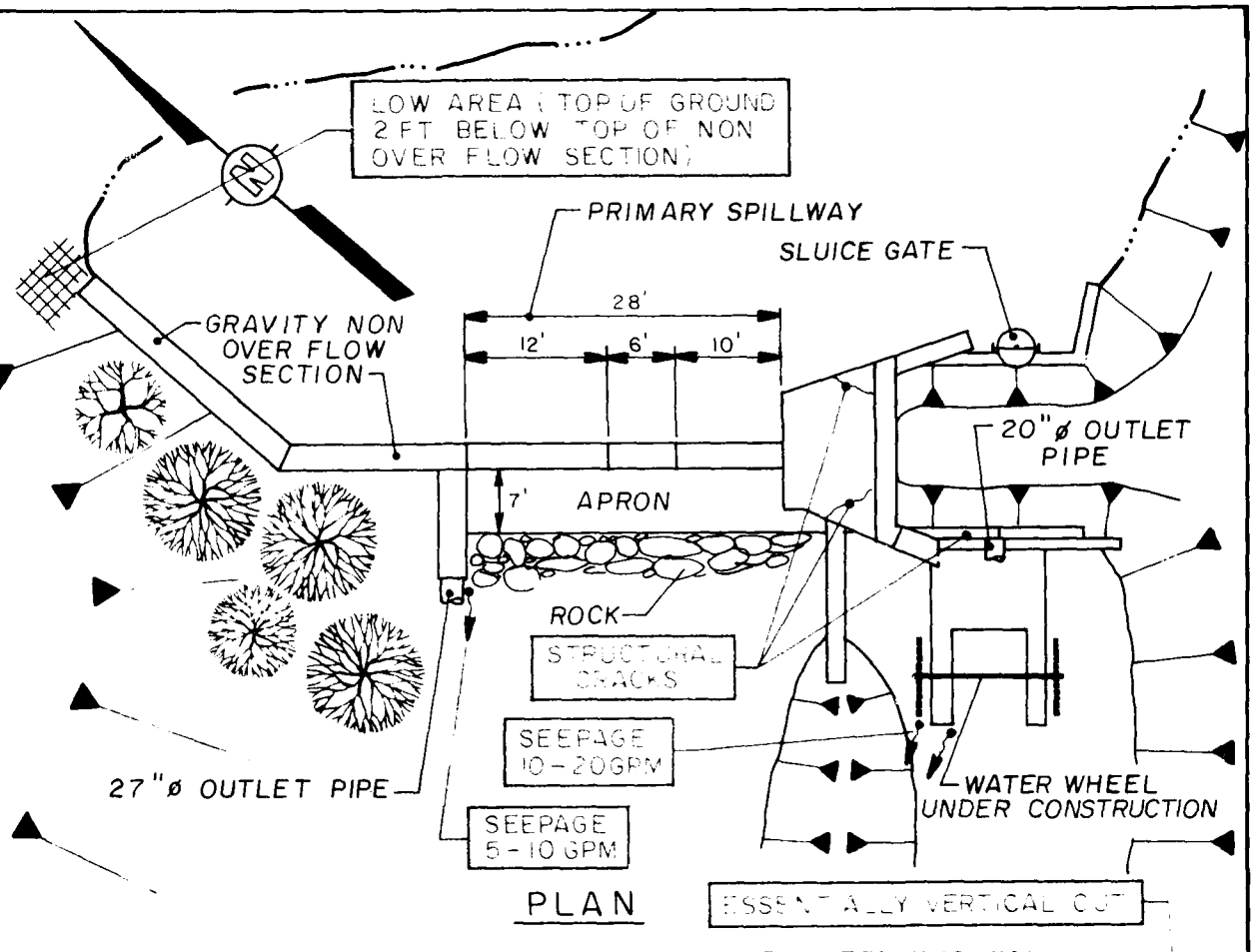


PLATE 3

TYRONE POWER COMPANY DAM
GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: JUNE 25, 1981

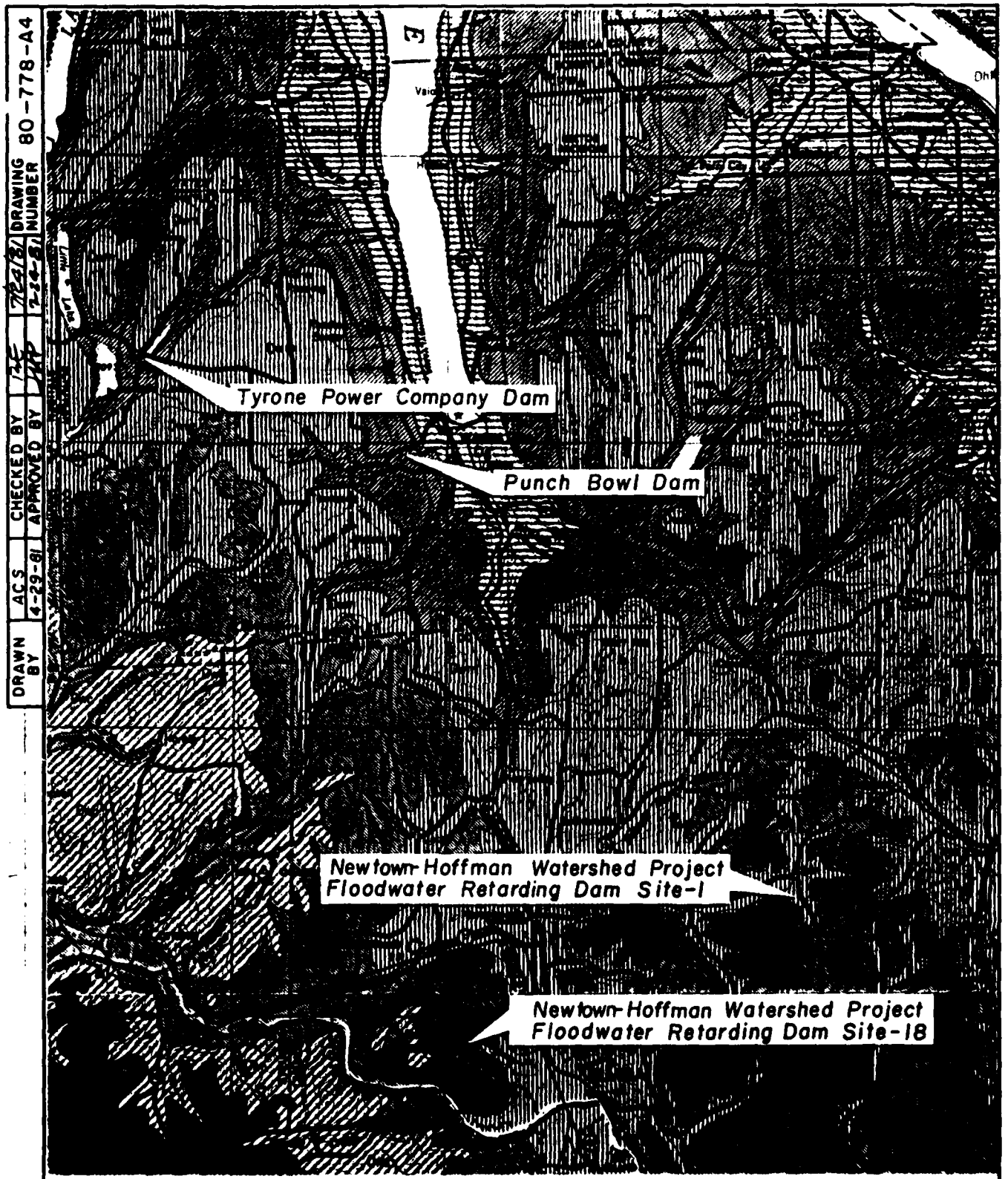
NOTE:

POOL LEVEL AT DATE OF INSPECTION : AT PRIMARY SPILLWAY CREST.

D'APPOLONIA

APPENDIX F

GEOLOGY MAP



DRAWN BY	ACS	CHECKED BY	[illegible]	DRAWING NUMBER	80-778-A4
	4-29-81	APPROVED BY	[illegible]		

GEOLOGY MAP

REFERENCE

GEOLOGIC MAP OF NEW YORK, FINGER LAKES SHEET
DATED 1970, SCALE 1 : 250,000

D'APPOLONIA

DRAWN BY	CHECKED BY		DRAWING NUMBER 80-778-A6
ACS 4-29-81	APPROVED BY JHD	5/7/81 5-7-81	

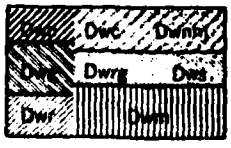
LEGEND

CANADAWAY GROUP
800-1200 ft. (240-370 m.)

Dcy — Machias Formation—shale, siltstone; Rushford Sandstone· Caneadea, Canisteo, and Hume Shales; Canaseraga Sandstone; South Wales and Dunkirk Shales; In Pennsylvania· Towanda Formation—shale, sandstone.

JAVA GROUP
300-700 ft. (90-210 m.)

Dj — Wiscoy Formation—sandstone, shale; Hanover and Pipe Creek Shales.

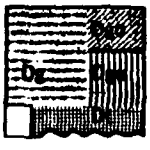


WEST FALLS GROUP
1100-1600 ft. (340-490 m.)

Dwr — Nunda Formation—sandstone, shale
Dwg — West Hill and Gardeau Formations—shale, siltstone; Roricks Glen Shale; upper Beers Hill Shale; Grimes Siltstone.
Dwl — lower Beers Hill Shale; Dunn Hill, Millport, and Moreland Shales.
Dwc — Nunda Formation—sandstone, shale; West Hill Formation—shale, siltstone; Corning Shale.
Dwnm — "New Milford" Formation—sandstone, shale.
Dwrg — Gardeau Formation—shale, siltstone; Roricks Glen Shale
Dws — Slide Mountain Formation—sandstone, shale, conglomerate.
Dwm — Beers Hill Shale; Grimes Siltstone; Dunn Hill, Millport, and Moreland Shales

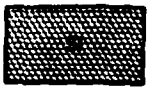
SONYEA GROUP
200-1000 ft. (60-300 m.)

Ds — In west: Cashaqua and Middlesex Shales.
In east: Rye Point Shale; Rock Stream ("Enfield") Siltstone; Pulteney, Sawmill Creek, Johns Creek, and Montour Shales.



GENESEE GROUP AND TULLY LIMESTONE
200-1000 ft. (60-300 m.)

Dg — West River Shale; Genundewa Limestone; Penn Yan and Geneseo Shales; all except Geneseo replaced eastwardly by Ithaca Formation—shale, siltstone and Sherburne Siltstone.
Dgc — Oneonta Formation—shale, sandstone
Dgu — Unadilla Formation—shale, siltstone.
Dt — Tully Limestone.



LOCKPORT GROUP
80-175 ft. (25-55 m.)

Sl — Oak Orchard and Penfield Dolostones, both replaced eastwardly by Sconondoa Formation—limestone, dolostone

GEOLOGY MAP LEGEND

REFERENCE
GEOLOGIC MAP OF NEW YORK, FINGER LAKES SHEET
DATED: 1970, SCALE 1 : 250,000

D'APPOLONIA

APPENDIX G

STABILITY ANALYSES

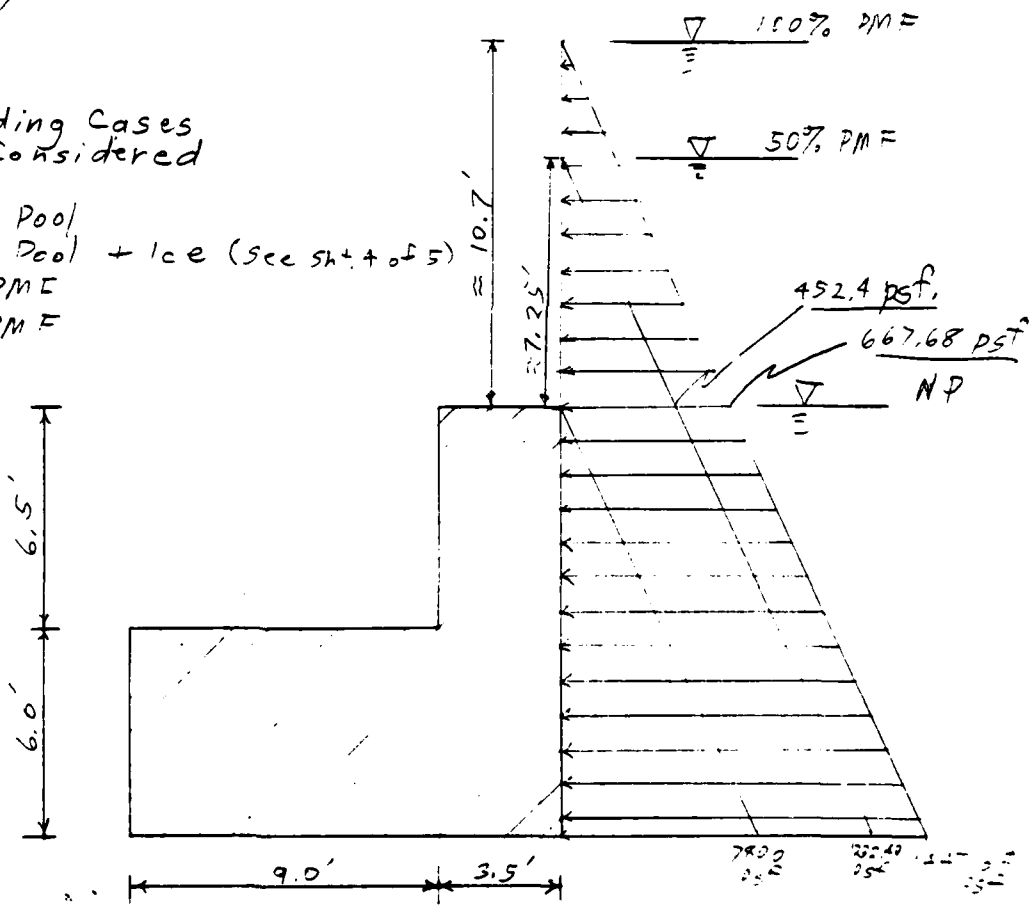
D'APPOLONIA
CONSULTING ENGINEERS, INC.

By MJC Date 8/4/81 Subject Tyrone Dam Sheet No. 1 of 7
Chkd. By [illegible] Date 08-06-81 Stability Calculations Proj. No. 80-7-R
0.5cm. X 0.5cm.

The attached sheet shows the details of the geometry of the dam observed on 6/24/81. The sketch below shows the approximate dimensions of the spillway cross section to be analyzed.

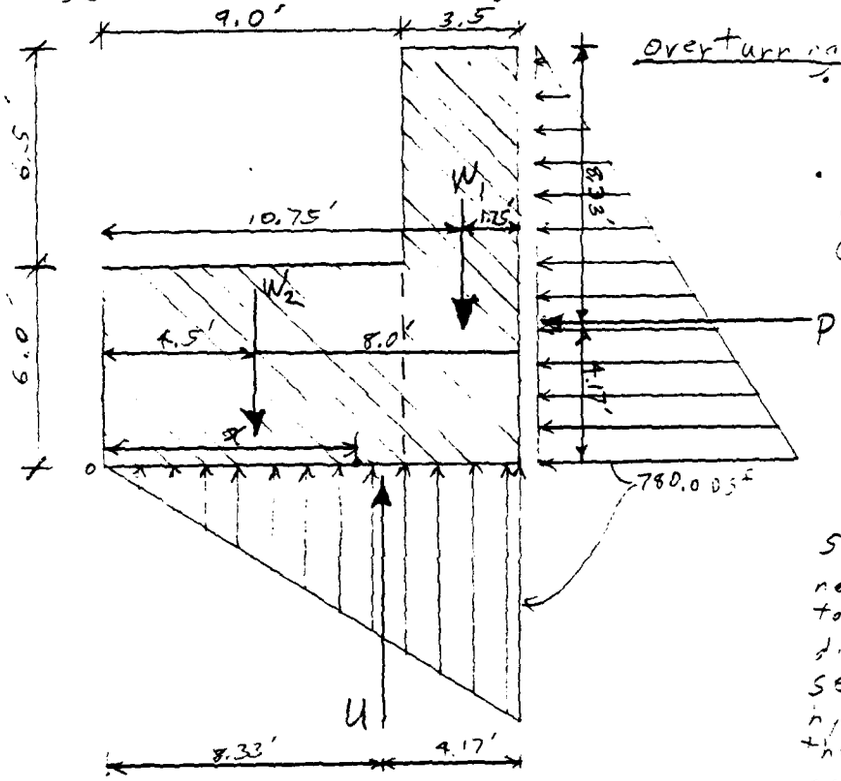
Four Loading Cases Will Be Considered

1. Normal Pool
2. Normal Pool + Ice (See Sht. 4 of 5)
3. 50% PMF
4. 100% PMF



The overtopping PMF heights were obtained from the results of a HEC-1 computer analysis. [illegible] of this data (copy) is attached to this [illegible].

Case 1 – Normal Pool Late Elevation



Overturning Stability Check

- Assume no tail water.
- Per 3.E. (8/5/81), assume no ice load on dam (due to observations during inspection)

Since the reservoir has no upstream sediment to cause pressure dissipation through seepage, use full hydrostatic head on the foundation for analysis.

Assume $\gamma_{concrete} = 150$ pcf

Consider a 1 ft thick section

$W_1 = 150\,(3.5)(12.5)(1.0) = 6562.5$ lb

$W_2 = 150\,(6.0)(9.0)(1.0) = 8100.0$ lb

$U = (780.0\ psf)(12.5)\cdot\frac{1}{2}\cdot(1.0) = 4875.0$ lb

$P = (780.0\ psf)(12.5)\cdot\frac{1}{2}\cdot(1.0) = 4875.0$ lb

$$(-)\Sigma M_o = W_1\left[9.0+\frac{3.5}{2}\right] + W_2\left[4.5\right] - P\left[\frac{12.5}{3}\right] - U\left[\frac{2(12.5)}{3}\right]$$

$$= 6562.5\,[10.75] + 8100.0[4.5] - 4875.0\,[12.5]$$

$$= 70546.9 + 36450.0 - 60937.5$$

$= 46059.4$ (ft.-lb.)

Position of resultant from point o

$$x = \frac{\oplus \Sigma M_o}{(W_1 + W_2 - U)} = \frac{46059.4}{(6562.5 + 8100.0 - 4875.0)} = \frac{46059.4}{9787.5}$$

$= 4.71$ ft.

U.S. Army Corps Of Engineers requires the position of the resultant to be located in the middle third of the base of the dam for overturning. (EM 1110-2-2200, p. 7, 9/25/58)

$$12.5'/3 \leq x \leq 2(12.5'/3)$$

$$\longrightarrow \quad 4.17' \leq x \leq 8.33'$$

Since $x = 4.71' \longrightarrow$ Overturning Stability Is Adequate

(Case 1, Cont'd) - Sliding Stability Check -

Table 1 of EM 1110-2-2200 (9/25/58) gives the ratio of the maximum horizontal force to maximum vertical force to preclude computing driving forces and shear resistances by equation (6) of the publication. For this case (Loading Condition II of Table 1), $\Sigma H / \Sigma V$ (max.) = 0.65

$\Sigma H = P = 4875.0$ lb.
$\Sigma V = W_1 + W_2 - U = 9787.5$ lb.

$$\frac{\Sigma H}{\Sigma V} = \frac{4875.0}{9787.5} = 0.50 < 0.65$$

Then, the required coefficient of friction is

$\tan \phi = 0.50$. Considering that the foundation material was observed to be shale (per B.E. 8-26-81), Table III of ETL 1110-2-184 (02-25-74) gives values of the friction angle, ϕ, for various typical shales. These are listed below

ROCK TYPE	ϕ	$\tan \phi$
Doniphan Shale	64°	2.05
Tecumseh Shale	51°	1.23
"Clay Shale	57°	1.54
Rochester Shale	68°	2.48
Degonia Shale	28°	0.53
Cucaracha Shale	38°	0.78
	$\Sigma \tan \phi$ =	8.61

(Friction) Mean $(\tan \phi) = 8.61/6 = 1.44$

$\rightarrow \bar{\phi} = \tan^{-1}(1.44) \approx 55°$

Implied Factor of Safety $F_s = 1.44/0.5$

$= 2.9$

Considering the above factor of Safety,

Conclusion $\rightarrow$ Sliding Stability is Adequate

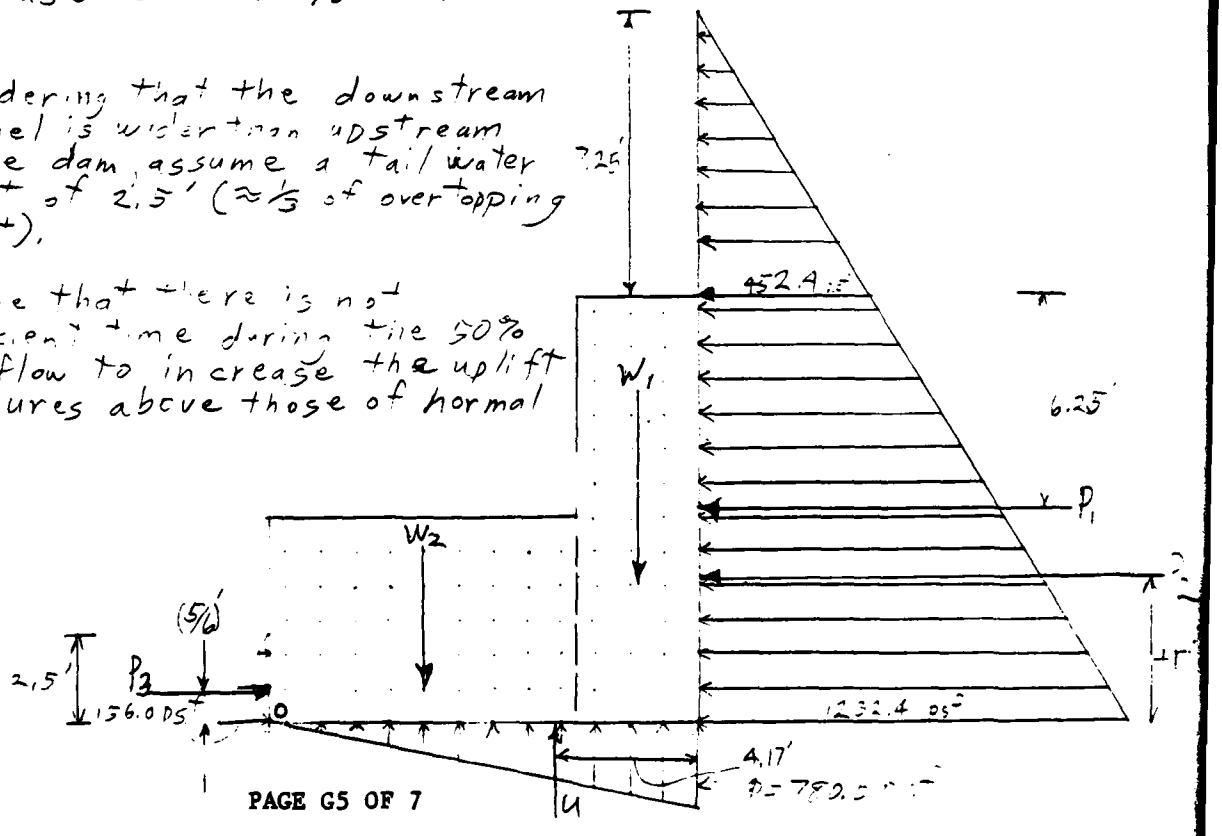
Case 2 - Normal Pool Plus Ice Load

In this case, EM 1110-2-2200 states that ice thickness is typically no greater than two feet thick. The recommended unit pressure for ice is 5000 psf. Assuming a 2 foot thick sheet of ice, a concentrated load of 10000 lb/ft. will be applied 11.5 ft above the base. By inspection, this force will cause overturing of the dam.

Case 3 - 50% PMF

Considering that the downstream channel is wider than upstream of the dam, assume a tail water height of 2.5' (≈1/5 of overtopping height).

Assume that there is not sufficient time during the 50% PMF flow to increase the uplift pressures above those of normal pool.



From Sheet 2 of 5

$W_2 = 8100.0$ lb
$W_1 = 6562.5$ lb
$U = (780.0)\frac{1}{2}(12.5)(1.0)$
$= 4875.0$ lb

$P_1 = 452.4(12.5)(1.0) = 5655.0$ lb
$P_2 = 780.0(12.5)\frac{1}{2}(1.0) = 4875.0$ lb
$P_3 = (156.0)(2.5)\frac{1}{2}(1.0) = 195.0$ lb

$$\oplus \Sigma M_o = W_2[4.5] + W_1[0.75] + P_3[5/6] - U[3/3(2.5)] - P_1[12.5/2] - P_2[2.5/3]$$
$$= 36450.0 + 70546.9 + 162.5 - 40625.0 - 35343.75 - 20312.5$$
$$= \underline{10878.1 \text{ ft-lb}}$$

Position of Resultant From Point O.

$$X = \frac{\oplus \Sigma M_o}{(W_1 + W_2 - U)} = \frac{10878.1}{(8100 + 6562.5 - 4875.0)} = \frac{10878.1}{9787.5}$$
$$= 1.11 \text{ ft} \longrightarrow \text{N.G.}$$

Required Position, $4.17' \leq X \leq 8.33'$

From EM 1110-2-2200:
Tension will be imposed on the concrete due to this loading and the dam will be subject to failure.
Conclusion: Stability is inadequate

Case 4 - 100% PMF STABILITY CHECK

By inspection, the dam is not stable under this loading.

D'APPOLONIA
CONSULTING ENGINEERS, INC.

By J.A.E. Date 8-26-81 Subject Tyrone Dam Sheet No. 7 of 7
Chkd. By BE Date 8/27/81 Stability Calculations Proj. No. 80-778
0.5cm. X 0.5cm.

Summary Of Results

Analysis Case *	Factor of Safety Overturning	Location of Resultan From Toe (Feet)	Factor of Safety Sliding
①	1.8 **	4.71	2.9
②	F	—	—
③	1.1 ***	1.11	—
④	F	—	—

* Refer To Sheet 1

F – indicates that the dam will fail in this case (by inspection – no analysis)

** (106996.9/66937.5) = 1.8

*** (107159.4/96281.25) = 1.1

— Analysis not performed, dam failure.

APPENDIX H

REFERENCES

APPENDIX H

REFERENCES

Broughton, J. G., D. W. Fisher, Y. W. Isachsen, and L. V. Rickard, 1966, "Geology of New York," New York State Museum and Science Service, Educational Leaflet 20, 50 pp.

Fisher, D. W., Y. W. Isachsen, and L. V. Rickard, 1971, "Generalized Tectonic-Metamorphic Map of New York," New York Museum and Science Service, Map and Chart Series No. 15.

Flint, R. F., 1971, Glacial and Quaternary Geology, John Wiley and Sons, Inc., 892 pp.

Rickard, L. V. and D. W. Fisher, 1970, "Geologic Map of New York, Finger Lakes Sheet," New York State Museum and Science Service, Map and Chart Series No. 15.

Thornburg, W. D., 1965, Regional Geomorphology of the United States, John Wiley & Sons, Inc., 609 pp.

U.S. Army Corps of Engineers, 1956, Hydrometeorological Report No. 33.

U.S. Department of Commerce, 1965, Weather Bureau Hydrometeorological Report No. 40.

U.S. Department of the Interior, Bureau of Reclamation, 1974, Design of Small Dams.

Wright, H. E., Jr. and D. G. Frey, 1965, The Quaternary of the United States, Princeton University Press, 922 pp.


DA
FILM